

ACM RESIDENTIAL MANUAL APPENDIX RB-2005

Appendix RB – Interior Mass Capacity

RB.1 Scope and Purpose

Interior Mass Capacity (IMC) is a measure of the total thermal mass in a low-rise residential building. IMC is used to determine if a building qualifies as a high mass building. Credit for thermal mass in the *Proposed Design* may only be considered when the *Proposed Design* qualifies as a high mass building. A high mass building is one with thermal mass equivalent to having 30 percent of the conditioned slab floor exposed and 15% of the conditioned non-slab floor exposed two inch thick concrete.

RB.2 Calculating Interior Mass Capacity (IMC)

The IMC for the building is calculated using Equation RB1. The IMC for the building is the sum of the area of each mass material multiplied times its Unit Interior Mass Capacity (UIMC). Table RB-1, Table RB-2, and Table RB-3 give UIMC values for a number of common thermal mass materials. This method allows for multiple mass types common in low-rise residential construction.

Equation RB-1

$$IMC = \sum_{i=1}^N A_i \times UIMC_i$$

where

IMC = Interior thermal mass of the building

A_i = Surface area of the i^{th} material

$UIMC_i$ = Unit Interior Mass Capacity (UIMC) of the i^{th} material selected from Table RB-1, Table RB-2, and Table RB-3

N = Number of thermal mass materials in the *Proposed Design*

RB.3 IMC Threshold for a High Mass Building

In order to qualify as a high mass building, the *Proposed Design* must have an IMC greater than or equal to that determined from Equation RD2. The IMC threshold is based on 30% of the conditioned slab area (CSA) being exposed (UIMC=4.6); 70% of the CSA being covered (UIMC=1.8); and 15% of the conditioned non-slab floor area as exposed two inch thick concrete (UIMC=2.5).

Equation RB-2

$$\begin{aligned} IMC_{\text{Threshold}} &= 0.3 \times 4.6 \times CSA + 0.7 \times 1.8 \times CSA + 0.15 \times 2.5 \times (CFA - CSA) \\ &= 2.640 \times CSA + 0.375 \times (CFA - CSA) \end{aligned}$$

where:

CSA = Conditioned Slab floor Area

CFA = Total Conditioned Floor Area

Table RB-1 – Interior Mass UIMC Values: Interior Mass¹¹- Surfaces Exposed on One Side¹³

Material	Surface Condition	Mass Thickness (inches)	Unit Interior Mass Capacity
Concrete Slab-on-Grade and Raised Concrete Floors	Exposed ¹	2.00	3.6
		3.50	4.6
		6.00	5.1
	Covered ²	2.00	1.6
		3.50	1.8
		6.00	1.9
Lightweight Concrete ⁹	Exposed	0.75	1.0
		1.00	1.4
		1.50	2.0
		2.00	2.5
	Covered	0.75	0.9
		1.00	1.0
		1.50	1.2
		2.00	1.4
Solid Wood ⁹	Exposed	1.50	1.2
		3.00	1.6
Tile ^{3,9}	Exposed	0.50	0.8
		1.00	1.7
		1.50	2.4
		2.00	3.0
Masonry ^{4,9}	Exposed	1.00	2.0
		2.00	2.7
		4.00	4.2
Adobe ⁹	Exposed	4.00	3.8
		6.00	3.9
		8.00	3.9
Framed Wall	0.50" Gypsum	na	0.0
	0.63" Gypsum	na	0.1
	1.00" Gypsum	na	0.5
	0.88" Stucco	na	1.1
Masonry Infill ⁷	0.50" Gypsum	3.50	1.3

Table RB-2 – Interior Mass UIMC Values: Interior Mass¹¹ - Surfaces Exposed on Two Sides^{5, 13}

Material	Surface Condition	Mass Thickness (inches)	Unit Interior Mass Capacity
Partial Grout Masonry ⁴	Exposed ¹	4.00	6.9
		6.00	7.4
		8.00	7.4
Solid Grout Masonry ^{4,6}	Exposed	4.00	8.3
		6.00	9.2
		8.00	9.6
Adobe	Exposed	4.00	7.6
		12.00	7.8
		16.00	7.6
Solid Wood/ Logs	Exposed	3.00	3.3
		4.00	3.3
		6.00	3.3
		8.00	3.3
Framed Wall	0.50" Gypsum	na	0.0
	0.63" Gypsum	na	0.2
	1.00" Gypsum	na	0.9
	0.88" Stucco	na	2.1
Masonry Infill ⁷	0.50" Gypsum	3.50	2.6

Table RB-3 – Exterior Wall Mass UIMC Values¹³

Material	Surface Condition	Mass Thickness (inches)	Wall U-value	Unit Interior Mass Capacity
Solid Wood/ Logs	Exposed ¹	3.00	0.22	0.7
		4.00	0.17	0.9
		6.00	0.12	1.1
		8.00	0.093	1.2
		10.00	0.075	1.3
		12.00	0.063	1.3
Wood Cavity Wall ¹²	Exposed	3.00 ¹²	0.11	1.1
			0.065	1.3
			0.045	1.4
Adobe	Exposed	8.00	0.35	2.1
		16.00	0.21	2.8
		24.00	0.15	3.1
Masonry Veneer ⁴	Framed Wall	4.00	0.10	na
			0.08	na
			0.06	na
Adobe Veneer	Framed Wall	4.00	0.10	na
			0.08	na
			0.06	na
Partial Grout Masonry ⁴	Exposed ¹	4.00	0.68	0.9
			0.58	1.0
		6.00	0.54	1.3
			0.44	1.5
		8.00	0.49	1.5
			0.38	1.7
	Furred ¹⁰	4.00	0.40	0.5
			0.30	0.5
			0.20	0.5
			0.10	0.5
			0.08	0.5
		6.00	0.40	0.9
			0.30	0.6
			0.20	0.5
			0.10	0.5
			0.08	0.5
		8.00	0.30	0.8
			0.20	0.5
			0.10	0.5
			0.08	0.5

Table RB-3: Exterior Wall Mass UIMC Values (continued)¹³

Material	Surface Condition	Mass Thickness (inches)	Wall U-value	Unit Interior Mass Capacity
Solid Grout Masonry ^{4,6}	Exposed	4.00	0.79	1.0
		6.00	0.68	1.5
		8.00	0.62	1.8
	Furred ¹⁰	4.00	0.40	0.5
			0.30	0.5
			0.20	0.5
			0.10	0.5
			0.08	0.5
		6.00	0.40	0.7
			0.30	0.5
			0.20	0.5
			0.10	0.5
			0.08	0.5
		8.00	0.40	0.8
			0.30	0.6
			0.20	0.5
			0.10	0.5
			0.08	0.5

RB.4 Table Notes

- "Exposed" means that the mass is directly exposed to room air or covered with a conductive material such as ceramic tile.
- "Covered" includes carpet, cabinets, closets or walls.
- The indicated thickness includes both the tile and the mortar bed, when applicable.
- Masonry includes brick, stone, concrete masonry units, hollow clay tile and other masonry.
- The unit interior mass capacity for surfaces exposed on two sides is based on the area of one side only.
- "Solid Grout Masonry" means that all the cells of the masonry units are filled with grout.
- The indicated thickness for masonry infill is for the masonry material itself.
- Use the Exterior Mass value for calculating Exterior Wall Mass.
- Mass located inside exterior walls or ceilings may be considered interior mass (exposed one side) when it is insulated on the exterior with at least R-11 insulation, or a total resistance of R-9 including framing effects.
- "Furred" means that 0.50-inch gypsum board is placed on the inside of the mass wall separated from the mass with insulation or an air space.
- When mass types are layered, e.g. tile over slab-on-grade or lightweight concrete floor, only the mass type with the greatest interior mass capacity may be accounted for, based on the total thickness of both layers.
- This wall consists of 3 inches of wood on each side of a cavity. The cavity may be insulated as indicated by the U-value column.
- Values based on properties of materials listed in 1993 ASHRAE Handbook of Fundamentals.